

SCOPE OF CLAIMS

1. An antenna device comprising a plurality of antennas corresponding to different frequencies, respectively, and switching means for switching between the antennas depending on a frequency.

2. An antenna device for use with a cellular phone for communicating with a radio base station, comprising:

a first antenna extensible from a housing of the cellular phone;

a second antenna stored in the housing of the cellular phone;

5 and

a frequency filter;

wherein only said second antenna is connected to a power feeder with said frequency filter interposed therebetween.

3. An antenna device for use with a cellular phone according to claim 2, wherein said first antenna is connected to said power feeder without said frequency filter interposed therebetween.

4. An antenna device for use with a cellular phone for communicating with a radio base station, comprising:

a first antenna storable in a housing of the cellular phone;

a second antenna stored in the housing of the cellular phone;

5 and

a third antenna mounted on a distal end of said first antenna and electrically insulated from said first antenna;

wherein only said second antenna is connected to a power feeder with a frequency filter interposed therebetween.

5. The antenna device for use with a cellular phone according to claim 4, wherein said first antenna or said third antenna is connected to said power feeder without said frequency filter interposed therebetween.

6. The antenna device for use with a cellular phone according to claim 4 or 5, wherein said third antenna comprises a helical antenna.

7. The antenna device for use with a cellular phone according to any one of claims 2 through 6, wherein said second antenna comprises a coiled antenna.

8. The antenna device for use with a cellular phone according to claim 7, wherein said coiled antenna has a space for storing said first antenna therein.

9. The antenna device for use with a cellular phone according to any one of claims 2 through 6, wherein said second antenna comprises a meander-line antenna.

10. The antenna device for use with a cellular phone according to claim 9, wherein said meander-line antenna has a space for storing said first antenna therein.

11. The antenna device for use with a cellular phone according to any one of claims 2 through 6, wherein said second antenna and said power feeder are mounted on one substrate.

12. The antenna device for use with a cellular phone according to any one of claims 2 through 6, wherein said second antenna comprises a meander-line antenna having a hollow semicylindrical shape or an inverted U-shaped cross section to provide a space for storing said first antenna therein, said meander-line antenna being fixed along a surface of a board and positioned to accommodate said first antenna therein.

13. The antenna device for use with a cellular phone according to any one of claims 2 through 6, wherein said second antenna is of a slender shape having a hollow semicylindrical or inverted U-shaped cross section perpendicular to a longitudinal direction thereof, with an open side of the hollow

5 semicylindrical or U-shaped antenna being fixed to a board, providing a space for storing said first antenna therein.

14. The antenna device for use with a cellular phone according to any one of claims 2 through 6, wherein said first antenna comprises a whip antenna and is connected to the power feeder when extended.

15. The antenna device for use with a cellular phone according to any one of claims 2 through 6, wherein said antenna device operates as an antenna having two resonant states by having a state in which said first antenna functions alone and a state in which said first antenna and said second antenna function when connected to each other through said frequency filter.

16. The antenna device for use with a cellular phone according to claim 14, wherein said first antenna functions alone at frequencies in a UHF band or higher, and said first antenna and said second antenna function at frequencies in a VHF band or lower when connected to each other through said frequency filter.

17. The antenna device for use with a cellular phone according to any one of claims 4 through 6, wherein said antenna device operates as an antenna having two resonant states by having a state in which said third antenna functions alone and a state in which said third antenna and said second antenna function when said first antenna is stored.

18. The antenna device for use with a cellular phone according to claim 16, wherein said third antenna functions alone at frequencies in the UHF band or higher, and said second antenna and said third antenna function at frequencies in the VHF band or lower.

19. The antenna device for use with a cellular phone according to any one of claims 2 through 17, wherein said frequency filter functions to

have a sufficiently high impedance value at frequencies in a UHF band and a sufficiently low impedance value at frequencies in a VHF band.

20. The cellular phone having an antenna device according to any one of claims 1 through 18.

21. A radio unit for receiving a plurality of broadcast waves, comprising:

an antenna for receiving TV broadcast waves including an UHF band and a VHF band and FM broadcast waves;

5 an earphone connector;

a TV/FM receiver for demodulating received TV broadcast waves including the UHF band and the VHF band and received FM broadcast waves; and

10 a selector switch for selectively connecting either one of said antenna and said earphone connector to said TV/FM receiver.

22. A radio unit for receiving a plurality of broadcast waves, comprising:

an antenna for sending and for receiving radio waves in a frequency band used by a cellular phone and receiving TV broadcast waves including an UHF band and a VHF band and FM broadcast waves;

5 an earphone connector;

a TV/FM receiver for demodulating received TV broadcast waves including the UHF band and the VHF band and received FM broadcast waves;

10 a frequency distributor for dividing radio waves received by said antenna into radio waves in the frequency band used by the cellular phone and TV broadcast waves and FM broadcast waves; and

a selector switch for selectively connecting either one of a line to which TV broadcast waves and FM broadcast waves divided by said frequency distributor are output and said earphone connector to said TV/FM receiver.

23. The radio unit for receiving a plurality of broadcast waves according to claim 21, further comprising:

an earphone detector for detecting a connected state of earphones with respect to the earphone connector and controlling the selector switch to connect said earphone connector and said TV/FM receiver to each other when the TV/FM receiver is in a state for receiving VHF broadcasts or FM broadcasts.

24. The radio unit for receiving a plurality of broadcast waves according to claim 23, further comprising:

an impedance switcher connected between said selector switch and said TV/FM receiver, said impedance switcher being switchable between a first impedance for optimizing reception of FM broadcast waves and TV broadcasts in the VHF band and a second impedance for optimizing reception of TV broadcasts in the UHF band;

wherein said earphone detector controls said impedance switcher to switch to said first impedance when said earphones are connected to said earphone connector and said TV/FM receiver receives TV broadcasts in the VHF band or FM broadcast waves.

25. The radio unit for receiving broadcast waves, comprising:

an antenna device according to any one of claims 2 through 18, for sending and receiving radio waves in a frequency band used by a cellular phone and for receiving TV broadcast waves including an UHF band and a VHF band and FM broadcast waves;

an earphone connector;

a TV/FM receiver for demodulating received TV broadcast waves including the UHF band and the VHF band and received FM broadcast waves;

10 a frequency distributor for dividing radio waves received by said antenna device into radio waves in the frequency band used by the cellular phone and TV broadcast waves and FM broadcast waves; and

 a switcher for selectively connecting either one of an output terminal for outputting TV broadcast waves and FM broadcast waves divided by
15 said frequency distributor and said earphone connector to said TV/FM receiver.

26. A radio unit for receiving broadcast waves, comprising:

 an antenna device for sending and receiving radio waves in a frequency band used by a cellular phone and for receiving TV broadcast waves including an UHF band and a VHF band and FM broadcast waves;

5 an earphone connector;

 a receiver for receiving broadcast waves including at least one of the UHF band and the VHF band which have been received;

 a frequency distributor for dividing radio waves received by said antenna device into radio waves in the frequency band used by the cellular
10 phone and broadcast waves; and

 a switcher for selectively connecting either one of an output terminal for outputting broadcast waves divided by said frequency distributor and said earphone connector to said receiver.

27. A radio unit for receiving broadcast waves, comprising:

 the antenna device according to any one of claims 2 through 18, for sending and receiving radio waves in a frequency band used by a cellular phone and receiving TV broadcast waves including an UHF band and a VHF
5 band and FM broadcast waves;

an earphone connector;

a receiver for receiving broadcast waves including at least one of the UHF band and the VHF band which have been received;

10 a frequency distributor for dividing radio waves received by said antenna device into radio waves in the frequency band used by the cellular phone and broadcast waves; and

a switcher for selectively connecting either one of an output end for outputting broadcast waves divided by said frequency distributor and said earphone connector to said receiver.

28. The radio unit for receiving broadcast waves according to claim 26 or 27, wherein earphones operable as an antenna can be connected to said earphone connector.

29. A radio unit for communicating with a radio base station, comprising:

a first antenna mounted on a housing of the radio unit, for receiving TV broadcast waves;

5 a second antenna stored in the housing of the cellular phone, for receiving TV broadcast waves;

a power feeder connected directly to said first antenna and connected to said second antenna through said frequency filter;

10 a frequency distributor connected to said power feeder, for dividing radio waves received by said first antenna and said second antenna into radio waves in a frequency band used by a cellular phone and TV broadcast waves;

a receiver for receiving TV broadcast waves;

a frequency filter for passing a VHF band therethrough;

15 an earphone connector;

an earphone detector for detecting a connected state of earphones with respect to said earphone connector; and

a switcher for connecting said earphone connector to said receiver if said earphone detector detects when earphones are connected to said earphone connector while said receiver is receiving broadcast waves in the VHF band.

30. A radio unit for communicating with a radio base station, comprising:

a first antenna mounted on a housing of the radio unit, for receiving TV broadcast waves;

a second antenna stored in the housing of the cellular phone, for receiving TV broadcast waves;

a power feeder connected directly to said first antenna and connected to said second antenna through said frequency filter;

a frequency distributor connected to said power feeder, for dividing radio waves received by said first antenna and said second antenna into radio waves in a frequency band used by a cellular phone and TV broadcast waves;

a receiver for receiving TV broadcast waves;

a frequency filter for passing a VHF band therethrough;

an earphone connector;

an earphone detector for detecting a connected state of earphones with respect to said earphone connector; and

a switcher for connecting an output terminal of said frequency distributor for outputting TV broadcast waves to said receiver while said receiver is receiving broadcast waves in a UHF band.

31. A radio unit for communicating with a radio base station,
comprising:

a first antenna mounted on a housing of the radio unit, for receiving TV broadcast waves;

5 a second antenna stored in the housing of the cellular phone, for receiving TV broadcast waves;

a power feeder connected directly to said first antenna and connected to said second antenna through said frequency filter;

10 a frequency distributor connected to said power feeder, for dividing radio waves received by said first antenna and said second antenna into radio waves in a frequency band used by a cellular phone and TV broadcast waves;

a receiver for receiving TV broadcast waves;

a frequency filter for passing a VHF band therethrough;

15 an earphone connector;

an earphone detector for detecting a connected state of earphones with respect to said earphone connector; and

20 a switcher for connecting an output terminal of said frequency distributor for outputting TV broadcast waves to said receiver if said earphone detector detects when earphones are not connected to said earphone connector while said receiver is receiving broadcast waves in the VHF band.

32. A radio unit for communicating with a radio base station,
comprising:

a first antenna mounted on a housing of the radio unit, for receiving TV broadcast waves;

5 a second antenna stored in the housing of the cellular phone, for receiving TV broadcast waves;

a power feeder connected directly to said first antenna and connected to said second antenna through said frequency filter;

10 a frequency distributor connected to said power feeder, for dividing radio waves received by said first antenna and said second antenna into radio waves in a frequency band used by a cellular phone and TV broadcast waves;

a receiver for receiving TV broadcast waves;

a frequency filter for passing a VHF band therethrough;

15 an earphone connector;

an earphone detector for detecting a connected state of earphones with respect to said earphone connector; and

a switcher for connecting said earphone connector to said receiver if said earphone detector detects when earphones are connected to said earphone connector while said receiver is receiving broadcast waves in the VHF band, connecting an output terminal of said frequency distributor for outputting TV broadcast waves to said receiver while said receiver is receiving broadcast waves in a UHF band, and connecting said power feeder to said receiver if said earphone detector detects when earphones are not connected to said earphone connector while said receiver is receiving broadcast waves in the VHF band.

33. The radio unit according to any one of claims 29 through 32, further comprising:

a third antenna mounted on a distal end of said first antenna and electrically insulated from said first antenna.

34. The radio unit according to any one of claims 29 through 33, wherein said first antenna comprises a whip antenna and is connected to the power feeder when extended.

35. The radio unit according to any one of claims 29 through 34, wherein said radio unit operates as an antenna having two resonant states by having a state in which said first antenna functions alone and a state in which said first antenna and said second antenna function when connected to each other through said frequency filter.

36. The radio unit according to any one of claims 29 through 35, wherein said first antenna functions alone at frequencies in a UHF band or higher, and said first antenna and said second antenna function at frequencies in a VHF band or lower when connected to each other through said frequency filter.

37. The radio unit according to any one of claims 29 through 36, wherein said second antenna comprises a coiled antenna.

38. The radio unit according to any one of claims 29 through 36, wherein said second antenna comprises a meander-line antenna.

39. The radio unit according to claim 33, wherein said third antenna comprises a helical antenna.

40. The radio unit according to claim 33 or 39, wherein said radio unit operates as an antenna having two resonant states by having a state in which said third antenna functions alone and a state in which said third antenna and said second antenna function when said first antenna is stored.

41. The radio unit according to any one of claims 33, 39, and 40, wherein said third antenna functions alone at frequencies in a UHF band or higher, and said second antenna and said third antenna function at frequencies in a VHF band or lower.